

NOTICE OF APPEAL TO THE  
BOARD OF PATENT APPEALS AND INTERFERENCES

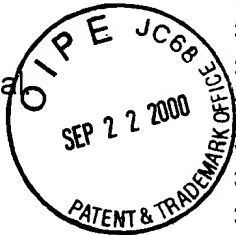
In re Application of:

Hideaki FUKUZAWA et al

Serial No.: 08/940,020

Filed: January 6, 1994

For: MAGNETORESISTANCE EFFECT  
DEVICE HAVING HARD  
MAGNETIC FILM STRUCTURAL  
BODY (as amended)



Group Art Unit: 2754

Examiner: D. Davis

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Assistant Commissioner for Patents  
Washington, D.C. 20231

Sir:

**APPEAL BRIEF**

In support of the timely filed Notice of Appeal filed June 6, 2000, and pursuant to 37 C.F.R. § 1.192, Appellants present in triplicate their brief accompanied by a check in the amount of \$680.00 to satisfy the fee under 37 C.F.R. § 1.17(c) and a two-month extension of time. This is an appeal to the Board of Patent Appeals and Interferences from the decision finally rejecting claims 21-23, 26, 47, 48, 60-65, 67-75, 77, and 78. The appealed claims are set forth in the attached Appendix. If any additional fees are required or if the enclosed payment is insufficient, please charge the deficiencies to our Deposit Account No. 06-0916. If a fee is required for an extension of time under 37 C.F.R. § 1.136 and such fee is not accounted for above, Appellants petition for such an extension and request that the fee be charged to the Deposit Account No. 06-0916.

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### **Real Party in Interest**

The real party in interest is KABUSHIKI KAISHA TOSHIBA, an assignee of Hideaki FUKUZAWA et al. for the above-captioned U.S. Patent Application.

### **Related Appeals and Interferences**

There are no other related pending appeals or interferences directly affected by or having a bearing on the decision in the pending appeal.

### **Status of Claims**

Pending claims 21-23, 26, 47, 48, 60-65, 67-75, 77, and 78 have been finally rejected and are the subject of this appeal.

Claims 1-20, 24, 25, 27-46, 49-59, 66, and 76 are claims that are currently not elected for prosecution, however, Appellants have traversed the restriction requirements presented by the Examiner and reserve the right to contest the propriety of those restriction requirements by Petition to the Commissioner. Further, with respect to non-elected claims depending from claims elected for prosecution, Appellants respectfully assert that those claims should be considered in condition for allowance should the claims from which they depend be deemed in condition for allowance as a result of this appeal.

In the February 29, 2000, final Office Action, the Examiner finally rejected claims 60, 67, and 77 under 35 U.S.C. § 112, first paragraph, as containing subject matter not enabled by the specification; and rejected claims 21-23, 26, 47, 48, 60-65, 67-75, 77,

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and 78 under 35 U.S.C. 103(a) as obvious over U.S. Patent No. 5,018,037 to Krounbi et al. ("Krounbi") in view of U.S. Patent No. 5,733,370 to Chen et al. ("Chen").

### **Status of Amendments**

All amendments filed by Appellants have been entered by the Examiner.

### **Summary of Invention**

The present invention is directed to a magnetoresistance effect device having a hard magnetic film structural body.

The disclosed magnetoresistance effect device includes a substrate 21 (page 44, line 1). On the substrate 21 is formed a magnetoresistance effect film 24 (figure 30). The magnetoresistance effect film 24 has a magnetic field detecting portion (page 1, lines 25-28). The magnetoresistance effect film may be formed as a spin valve film 24 including a ferromagnetic film and a non-magnetic film (page 1, lines 24-25).

A pair of bias magnetic field applying films 25 (comprised of elements 15-17 in figure 30 (page 44, lines 23-27)) are disposed adjacent both edge portions of the magnetic field detecting portion (figure 30). In one arrangement the pair of bias magnetic field applying films are abutted against the magnetoresistance effect film (figure 30). The bias magnetic field applying films have hard magnetic films 17 containing Co as a structural element (page 44, lines 26-27). The hard magnetic films 17 have a bi-crystal structure (page 39, lines 12-13). The hard magnetic films may have a residual magnetization  $M_r$  of 650 emu/cc or more (page 26, lines 15-16).

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In one arrangement the hard magnetic films 17 have Co(110) oriented perpendicular to the surface thereof (page 26, lines 3-6). Examples of materials for forming the hard magnetic films include CoPt and CoCrPt (Table 4).

As shown in figure 30, the magnetoresistive effect device can be formed as part of a magnetic head. The magnetic head of figure 30 includes a lower magnetic shield layer 22 (page 44, line 3), a lower reproduction magnetic gap 23 (page 44, line 8), and an upper magnetic shield layer 29 (page 46, line 3). Figure 30 also shows a recording head 31 having a lower record magnetic pole 29 (page 46, line 13-16). A record magnetic gap 32 is formed on the lower magnetic pole 29 (page 46, lines 18-21) and a recording coil for applying a record magnetic field to the lower magnetic pole 29 and the upper magnetic pole 33 is formed (page 46, lines 23-26).

The present invention also includes an underlayer 18 having a range of thicknesses up to and including 50nm (page 23, lines 7-8). As shown in figure 1 the underlayer 18 includes an amorphous layer 13 and a crystal layer 14 formed on the amorphous layer (page 22, lines 1-3). The crystal layer 14 is part of a metal crystal layer (page 22, line 6-8) that also includes a crystal metal base film 16 (page 22, lines 6-8). The crystal metal base film 16 may comprise a crystal metal material having a bcc structure (page 22, line 16-17). Materials for use in the crystal metal base film 16 include chromium, vanadium or alloys thereof (page 22, line 26-27).

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### Issues

The issues presented in this appeal brief are:

A. Whether the Examiner has improperly rejected claims 60, 67, and 77 under 35 U.S.C. § 112, first paragraph, as lacking enablement.

B. Whether the Examiner has improperly rejected claims 21-23, 26, 47, 48, 60-65, 67-75, 77, and 78 under 35 U.S.C. § 103(a) as being unpatentable over Krounbi in view of Chen.

### Grouping of Claims

The following groups of claims are considered to be separately patentable:

Group I: Claims 21, 23, 26, 47, and 48

Group II: Claim 22

Group III: Claim 60

Group IV: Claims 62, 64, 65, 68, and 69

Group V: Claim 63

Group VI: Claim 67

Group VII: Claims 70, 71, 73, 75, and 77

Group VIII: Claim 72

Group IX: Claim 74

The groups of claims do not stand or fall together. The reason Appellants consider the groups of claims to be separately patentable is that the groups of claims define different embodiments of the present invention. With respect to each of the

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groups of claims different or alternative arguments as to the patentability of the claims apply.

### Argument

#### **A. Claims 60, 67, and 77 Have Been Improperly Rejected Under 35 U.S.C. § 112, First Paragraph.**

Regarding the Section 112 rejection of claims 60, 67, and 77 as lacking enablement, Appellants respectfully traverse this rejection. The ground presented by the Examiner is that "[t]he specification fails to enable a skilled artisan how to make and/or utilize an underlayer having a thickness approaching zero."

[Appellants assert that there is no basis in law or in technical reasoning for the Examiner's assertion of lack of enablement.] Appellant did not state a range starting at zero, but rather recited a thickness less than a finite amount. Appellants respectfully assert that a person having ordinary skill in the art would have no difficulty in understanding the proper scope of the recited claim language or in providing an underlayer as recited in the claims. Appellants, therefore, assert that claims 60, 67, and 77 are fully in compliance with the requirements of § 112.

By performing a brief search of the United States Patent and Trademark Office database on September 11, 2000, Appellants found 285,518 uses of the claim language "less than." In accordance with the Examiner's arguments many of these claims would be indefinite under § 112, however, Appellants fail to conceive of how that many invalid claims could be issued by the Patent Office between 1976 and today.

Further, Appellants found 1,085,978 uses of the claim language "at least" and 259,183 uses of the claim language "more than." In accordance with the Examiner's interpretation of Appellants claims, many if not all of these claims would also fail to be enabled. Specifically, due to the limited resources available in the universe it would be impossible to have an infinite number of something.

Appellants assert that the operative question is whether a person having ordinary skill in the art would be able to make and/or use the claimed invention. The Examiner has provided no rebuttal to Appellants past arguments regarding the enablement of the claims. Instead, in the final Office Action of February 29, 2000, the Examiner simply used the same arguments previously presented. No reasoned argument has been presented of why a person having ordinary skill in the art would not be able to make and or use the claimed invention. Appellants, therefore, request that the rejection of claims 60, 67, and 77, as lacking enablement be withdrawn.

**B. Claims 21-23, 26, 47, 48, 60-65, 67-75, 77, and 78 have been Improperly Rejected Under 35 U.S.C. § 103(a) as being Unpatentable over Krounbi in View of Chen.**

Regarding the rejection of the all of the pending claims as being unpatentable over Krounbi in view of Chen, Appellants note with dismay that the Examiner has failed at any time during the prosecution of this application to address in any meaningful way the substantive arguments made by Appellants regarding the patentability of the claims over this cited prior art. Whether the Examiner agrees or disagrees with the arguments presented, Appellants feel that the dismissal of those arguments without comment

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substantially precludes the efficient prosecution of the pending application. Appellants have, therefore, brought this appeal before the Board of Patent Appeals and Interferences in hopes of receiving a substantive review of the pending claims and the arguments presented as to the patentability of those claims.

#### Claim 21

Regarding the rejection of claim 21, this claim is directed to a combination including a substrate having a main surface, a magnetoresistance effect film formed on the main surface of the substrate and having a magnetic field detecting portion, a pair of bias magnetic field applying films disposed adjacent to both edge portions of the magnetic field detecting portion, the bias magnetic field applying films having hard magnetic films containing Co as a structural element and having a bi-crystal structure.

At page 4 of the Office Action dated February 29, 2000, the Examiner admitted that Krounbi fails to teach or suggest bias magnetic field applying films having hard magnetic films containing cobalt as a structural element and being a bi-crystal structure. Appellants agree that no such teaching is present in Krounbi.

In order to meet the claim recitation the Examiner cited Chen as teaching "magnetic field applying films having hard magnetic films containing cobalt (Co) as a structural element being a bi-crystal structure." The Examiner argued that:

it would have been obvious to provide the cobalt magnetic field applying films having hard magnetic films containing cobalt (Co) as structural element of Krounbi et al with a bi-crystal structure as taught by Chen et al [because] . . . one of ordinary skill in the art at the time the invention was made would have been motivated to provide magnetic field applying films having hard magnetic films containing cobalt (Co) as a structural element with a bi-crystal structure to suppress Barkhausen noise in the magnetic head. See column 3, lines 37-50 of Chen et al.

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As Appellants have repeatedly pointed out during the prosecution of this application, Chen neither mentions nor alludes to Barkhausen noise anywhere in the patent. The Examiner's assertion that Chen teaches the suppression of Barkhausen noise is entirely unsupported by any technical or logical reasoning. The cited passage of Chen in its entirety states:

[t]he magnetic recording medium disclosed in copending application U.S. Ser. No. 08/586,571, the entire disclosure of which is incorporated herein by reference, exhibits dramatically reduced *medium noise* attributed to the formation of a magnetic alloy layer exhibiting a bicrystal cluster microstructure as shown in FIG. 2. With continued reference to FIG. 2, cobalt (Co)-based alloy 21 having a bicrystal cluster microstructure 22 is formed on a Cr underlayer 20 which exhibits a (200) crystallographic texture or orientation. Arrow 23 denote the C axes of the deposited Co-based alloy microstructure. The formation of an underlayer exhibiting a (200) crystallographic orientation enables the obtainment of a bicrystal cluster microstructure in a magnetic alloy layer epitaxially grown thereon.

(emphasis added). The word "Barkhausen" is neither mentioned nor alluded to in the entire passage.

Despite Appellants repeated protestations, however, the Examiner failed to provide any argument in support of the interpretation of Chen. Appellants assert that the interpretation relied upon by the Examiner is nothing more than hindsight intended to meet the limitations of the pending claims. The Federal Circuit has repeatedly admonished against the use of hindsight in crafting rejections. See e.g., *In re Corkill*, 771 F.2d 1496 (Fed. Cir. 1985) (discussing hindsight as a "syndrome wherein that which only the inventor taught is used against its teacher"), *In re McCarthy*, 763 F.2d 411 (Fed. Cir. 1985) (stating that the use of hindsight is a practice that the Federal Circuit has consistently deplored), *In re Piasecki*, 745 F.2d 1468 (Fed. Cir. 1984).

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That the term "bi-crystal" has been used in the patent literature is in and of itself not relevant, as knowledge alone is simply insufficient to render the claims unpatentable. Instead, far more is required in order to provide a *prima facie* case of obviousness against the claimed invention.

[ At the very least Appellants again request that the Examiner provide any evidence at all that the medium noise discussed by Chen is related in any way to the Barkhausen noise cited by the Examiner as providing the motivation to combine the cited references. Appellants respectfully assert that based on the evidence currently provided there is absolutely no relationship between the two disparate effects other than the word "noise" being used as part of the term describing the two effects. Such a tenuous grammatical link provides neither sufficient technical basis nor sufficient motivation to sustain the pending rejection. ]

Still further, Appellants assert that the two references cited by the Examiner do not comprise analogous art. According to the Manual of Patent Examining Procedure "[i]n order to rely on a reference as a basis for rejection of an applicant's invention, the reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." Chen fails to either be in the same field of endeavor or reasonably pertinent to the particular problem. [ Specifically, the field of endeavor of magnetic storage media is not properly interpreted as the same field of endeavor as magnetoresistive effect devices. Further, there is no proper reason to assert that the magnetic recording medium of Chen is pertinent to the problem of Barkhausen noise in a magnetoresistive head. The problem of Barkhausen noise in a magnetic recording medium is simply not addressed

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anywhere in the cited prior art. The magnetic storage medium of Chen, therefore, is simply not pertinent to the problem addressed by Appellants.

Because the pending rejection of claim 21 is based, in its entirety, on flawed technical reasoning, patent hindsight, and non-analogous art, Appellants request that the rejection of claim 21 as being unpatentable over Krounbi in view of Chen be withdrawn.

#### Claim 22

Regarding the rejection of claim 22 as being unpatentable over Krounbi in view of Chen, Appellants respectfully traverse this rejection. Claim 22 is patentable over the cited prior art, at least, in view of its dependence from claim 21. Further, claim 22 recited that the hard magnetic film has a Co(110) oriented perpendicular to the surface thereof.

The Examiner asserts at page 3 of the Office Action that the hard magnetic film of Krounbi "is considered to have Co(110) crystallographic orientation oriented perpendicular to the surface." With all due respect to the Examiner's "considered" opinion, such an opinion is entirely irrelevant. Without basis in any of the prior art the Examiner has decided by *fiat* that the claimed invention as recited in claim 22 is unpatentable. The Examiner has based the conclusion of unpatentability on neither legal nor technical reasoning. The Examiner simply has no power to decide what is and is not patentable using conjecture or opinion. Appellants, therefore, request that the rejection of claim 22 be withdrawn.

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Claims 23, 26, 47, and 48

Regarding claims 23 and 26 these claim are patentable, at least, in view of their dependence from claim 21. Regarding claims 47, 48, these claims incorporate all of the subject matter of claim 21. For essentially the same reasons expressed above with respect to claim 21, therefore, claims 47, 48 are patentable over the applied references.

Claim 60

Regarding the rejection of claim 60, this claim is patentable over the applied references, at least, in view of its dependence from claim 21. Further, claim 60 requires an underlayer formed between a substrate and a hard magnetic layer, the underlayer being composed of an amorphous layer formed on the substrate and a crystal layer formed on the amorphous layer.

The Examiner asserts at page 5 of the Office Action "[i]t additionally would have been obvious to a person having ordinary skill in the art at the time the invention was made to provide the magnetic head of Krounbi et al with a amorphous underlayer . . . [because] one of ordinary skill in the art at the time the invention was made would have been motivated to provide . . . a magnetic read head able to read a high density on a magnetic recording medium." It is unclear from the text of the rejection what aspect of the prior art the Examiner is relying upon to support this contention. Specifically, the Examiner has failed to cite any teaching or suggestion in the prior art as to the use of an amorphous underlayer resulting in a magnetic read head able to read a high density. The rejection, in fact, fails to cite the prior art as even teaching the amorphous underlayer itself let alone the purported motivation to combine.

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The only reference relied upon by the Examiner to show a magnetic head is Krounbi, however, that reference fails to mention the use of an amorphous underlayer or to remotely suggest the advantage cited by the Examiner. Again, this rejection has been crafted whole cloth simply to meet the claim recitation. Such a use of hindsight is impermissible.

In view of the above Appellants respectfully request that the rejection of claim 60 be withdrawn.

#### Claim 62

Regarding the rejection of claim 62, this claim is patentable over the cited prior art for at least essentially the same reasons expressed above with respect to claim 21. Further, claim 62 requires hard magnetic films having residual magnetization of 650 emu/cc. The Examiner states at page 3 of the Office Action that the hard magnetic film of Krounbi is "considered to have a residual magnetization Mr of 650 emu/cc." Appellants find absolutely no basis in legal or technical reasoning to support the Examiner's conclusion. It is unclear to Appellants what relevance the Examiner's considered opinion is purported to have to the prosecution of this application. The Examiner may not simply assume that the prior art teaches something without further support. If the burden of proof on the Examiner were simply to state what he/she feels the prior art might be teaching the standard of patentability provided by the patent laws of the United States would appear to have little if no meaning. This rejection is neither factually nor legally proper, and therefore, Appellants respectfully request that it be withdrawn.

Claim 63

Regarding claim 63, this claim is patentable over the cited references, at least, in view of its dependence from claim 62 and for at least essentially the same reasons expressed above with respect to claim 22.

Claims 64, 65, 68, 69

Regarding claims 64, 65, and 68, these claims are patentable over the cited references, at least, in view of their dependence from claim 62. Regarding claim 69, this claim incorporates all of the subject matter of claim 62, and therefore, is patentable over the cited references for at least essentially the same reasons expressed above with respect to claim 62.

Claim 67

Regarding claim 67, this claim is patentable over the cited references, at least in view of its dependence from claim 62 and for at least essentially the same reasons expressed above with respect to claim 60.

Claim 70

Regarding claim 70, this claim is patentable over the cited references for at least essentially the same reasons expressed above with respect to claim 60.

Claim 71

Regarding claim 71, this claim is patentable over the cited references, at least, in view of its dependence from claim 70.

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#### Claim 72

Regarding claim 72, this claim is patentable over the cited references, at least, in view of its dependence from claim 70 and for at essentially the same reasons expressed above with respect to claim 62.

#### Claims 73, 75, 77 and 78

Regarding claims 73, 75, and 77, these claims are patentable over the cited references, at least, in view of their dependence from claim 70. Regarding claim 78, this claim incorporates all of the limitations of claim 70, and therefore, is patentable over the cited references for at least essentially the same reasons expressed above with respect to claim 70.

#### Claim 74

Regarding claim 74, this claim is patentable over the cited references, at least, in view of its dependence from claim 70 and for at least essentially the same reasons expressed above with respect to claim 21.

#### Conclusion

Appellants respectfully request the review and reconsideration of the pending rejections of the claims. Based on even the broadest reasonable interpretation of the claims, Appellants assert that the claims are fully in compliance with the requirements of 35 U.S.C. § 112. With respect to the prior art rejections of the claims, the pending rejections are mere hindsight in view of Appellants' claimed invention. The references fail remotely to teach or suggest the claimed combination. Further, the references themselves are not analogous prior art.

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To the extent any further extension of time under 37 C.F.R. § 1.136 is required to obtain entry of this Appeal Brief, such extension is hereby respectfully requested. If there are any fees due under 37 C.F.R. §§ 1.16 or 1.17 which are not enclosed herewith, including any fees required for an extension of time under 37 C.F.R. § 1.136, please charge such fees to our Deposit Account No. 06-0916.

Respectfully submitted,

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## Appendix

1. A hard magnetic film structural body, comprising:  
a substrate having a main surface;  
a crystal metal base film formed on the main surface of said substrate;  
an amorphous layer formed between said substrate and said crystal metal base film; and  
a hard magnetic film formed on said crystal metal base film and containing Co as a structural element, said hard magnetic film having a bi-crystal structure.
2. The hard magnetic film structural body as set forth in claim 1,  
wherein said amorphous layer is a reactive layer of the substrate and the crystal metal base film.
3. The hard magnetic film structural body as set forth in claim 1,  
further comprising a reactive metal crystal layer disposed between the crystal metal base film and the amorphous layer.
4. The hard magnetic film structural body as set forth in claim 1,  
wherein said substrate has a surface layer on the main surface side, the surface layer being composed of at least one selected from the group consisting of an oxide, a nitride, and a carbide.
5. The hard magnetic film structural body as set forth in claim 1,

wherein said hard magnetic film containing Co as a structural element has Co (110) oriented perpendicular to the surface thereof.

6. The hard magnetic film structural body as set forth in claim 1,  
wherein said crystal metal base film contains at least one element selected from the group consisting of Cr, V, Ti, Ta, W, Zr, Nb, Hf, Mo, and Al.
7. The hard magnetic film structural body as set forth in claim 1,  
wherein said crystal metal base film has a bcc (200) orientation component.
8. The hard magnetic film structural body as set forth in claim 1,  
wherein the total film thickness of said crystal metal base film and said amorphous layer is 50 nm or less.
9. The hard magnetic film structural body as set forth in claim 1,  
wherein the average diameter of crystal grains of said crystal metal base film is five times or more the thickness thereof.
10. The hard magnetic film structural body as set forth in claim 1,  
wherein said hard magnetic film has main-grains and subgrains, the diameter of the main-grain being 50 nm or more, each of the main-grains having the sub-grains.
11. The hard magnetic film structural body as set forth in claim 1,

wherein said crystal metal base film and said amorphous layer are magnetic layers.

12. A hard magnetic film structural body, comprising:

a substrate having a main surface;

a crystal metal base film formed on the main surface of said substrate;

a mixing layer formed between said substrate and said crystal metal base film and containing structural elements of said substrate and structural elements of said crystal metal base film; and

a hard magnetic film formed on said crystal metal base film and containing Co as a structural element, said hard magnetic film having a bi-crystal structure.

13. The hard magnetic film structural body as set forth in claim 12,

wherein said substrate has a surface layer on the main surface side, the surface layer being composed of at least one selected from the group consisting of an oxide, a nitride, and a carbide.

14. The hard magnetic film structural body as set forth in claim 12,

wherein said hard magnetic film containing Co as a structural element has Co (110) oriented perpendicular to the surface thereof.

15. The hard magnetic film structural body as set forth in claim 12, wherein said crystal metal base film contains at least one element selected from the group consisting of Cr, V, Ti, Ta, W, Zr, Nb, Hf, Mo, and Al.
16. The hard magnetic film structural body as set forth in claim 12, wherein said crystal metal base film has a bcc (200) orientation component.
17. The hard magnetic film structural body as set forth in claim 12, wherein the total film thickness of said crystal metal base film and said mixing layer is 50 nm or less.
18. The hard magnetic film structural body as set forth in claim 12, wherein the average diameter of crystal grains of said crystal metal base film is five times or more the thickness thereof.
19. The hard magnetic film structural body as set forth in claim 12, wherein said hard magnetic film has main-grains and sub-grains, the diameter of the main-grain being 50 nm or more, each of the main-grains having the sub-grains.
20. The hard magnetic film structural body as set forth in claim 12, wherein said crystal metal base film and said mixing layer are magnetic layers.
21. A magnetoresistive effect device, comprising:

a substrate having a main surface;

a magnetoresistance effect film formed on the main surface of said substrate and having a magnetic field detecting portion;

a pair of bias magnetic field applying films disposed adjacent to both edge portions of the magnetic field detecting portion, the bias magnetic field applying films having hard magnetic films containing Co as a structural element and having a bi-crystal structure.

22. The magnetoresistance effect device as set forth in claim 21,

wherein said hard magnetic film containing Co as a structural element has Co(110) oriented perpendicular to the surface thereof.

23. The magnetoresistance effect device as set forth in claim 21,

wherein said hard magnetic film is composed of CoPt or CoCrPt.

24. The magnetoresistance effect device as set forth in claim 21,

further comprising a metal crystal layer as a base film of the hard magnetic film, said metal crystal layer containing at least one selected from Cr and V.

25. The magnetoresistance effect device as set forth in claim 21,

wherein said magnetoresistance effect film is formed so that at least both edge portions thereof are layered on said pair of bias magnetic field applying films, said

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magnetoresistance effect film exchange-coupling said bias magnetic field applying films.

26. The magnetoresistance effect device as set forth in claim 21,  
wherein said pair of bias magnetic field applying films are abutted against said magnetoresistance effect film.

27. A magnetoresistance effect device, comprising:  
a substrate having a insulating layer as a surface layer;  
a magnetoresistance effect film formed on the insulating layer of said substrate and having a magnetic field detecting portion;  
a pair of bias magnetic field effect films disposed adjacent to both edge portions of the magnetic field detecting portion and having an amorphous layer, a metal crystal layer, and a hard magnetic film containing Co as a structural element successively layered on the insulating layer of said substrate; and  
a pair of electrodes for supplying a current to said magnetoresistance effect film.

28. A magnetoresistance effect device as set forth in claim 27,  
wherein said amorphous layer contains structural elements of said insulating layer of the substrate and structural elements of said metal crystal layer.

29. The magnetoresistance effect device as set forth in claim 28,

wherein said amorphous layer is a reactive layer of the insulating layer and the metal crystal layer.

30. The magnetoresistance effect device as set forth in claim 27,  
wherein the metal crystal layer has a crystal metal base film, and a reactive crystal layer.
31. The magnetoresistance effect device as set forth in claim 27,  
wherein said metal crystal layer contains at least one selected from Cr and V.
32. The magnetoresistance effect device as set forth in claim 20,  
wherein said insulating layer is composed of at least one selected from the group consisting of an oxide, a metal nitride, and a carbide.
33. The magnetoresistance effect device as set forth in claim 27,  
wherein said metal crystal layer contains at least one selected from Cr and V.
34. The magnetoresistance effect device as set forth in claim 33,  
wherein said hard magnetic film containing Co as a structural element has Co (110) oriented perpendicular to the surface thereof.
35. The magnetoresistance effect device as set forth in claim 27,  
wherein said hard magnetic film is composed of CoPt or CoCrPt.

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36. The magnetoresistance effect device as set forth in claim 27,  
wherein said magnetoresistance effect film is formed so that at least both edge portions thereof are layered on said pair of bias magnetic field applying films, said magnetoresistance effect film exchange-coupling said bias magnetic field applying films.

37. The magnetoresistance effect device as set forth in claim 27,  
wherein said pair of bias magnetic field applying films are abutted against said magnetoresistance effect film.

38. A magnetoresistance effect device, comprising:  
substrate having a main surface;  
magnetoresistance effect film formed on the main surface of said substrate and having a magnetic field detecting portion;  
a pair of bias magnetic field effect films disposed adjacent to both edge portions of the magnetic field detecting portion and having a crystal metal base film on the main surface of the substrate, a mixing layer formed between the substrate and the crystal metal base film and containing structural elements of the substrate and structural elements of said crystal metal base film, and a hard magnetic film formed on the crystal metal base film and containing Co as a structural element; and  
a pair of electrodes for supplying a current to said magnetoresistance effect film.

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39. A magnetoresistance effect device as set forth in claim 38,  
wherein said mixing layer is an amorphous layer.
40. The magnetoresistance effect device as set forth in claim 38,  
wherein said crystal metal base film contains at least one selected from Cr and  
V.
41. The magnetoresistance-effect-device as set forth in claim 38,  
wherein said substrate has a surface layer disposed on the main surface side,  
the surface layer being composed of at least one selected from the group consisting of  
an oxide, a nitride, and a carbide.
42. The magnetoresistance effect device as set forth in claim 38,  
wherein said hard magnetic film containing Co as a structural element has a bi-  
crystal structure.
43. The magnetoresistance effect device as set forth in claim 42,  
wherein said hard magnetic film containing Co as a structural element has Co  
(110) oriented perpendicular to the surface thereof.
44. The magnetoresistance effect device as set forth in claim 38,  
wherein said hard magnetic film is composed of CoPt or CoCrPt.

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45. The magnetoresistance effect device as set forth in claim 38,  
wherein said magnetoresistance effect film is formed so that at least both edge portions thereof are layered on said pair of bias magnetic field applying films, said magnetoresistance effect film exchange-coupling said bias magnetic field applying films.
46. The magnetoresistance effect device as set forth in claim 38,  
wherein said pair of bias magnetic field applying films are abutted against said magnetoresistance effect film.
47. A magnetic head, comprising:  
a lower magnetic shield layer;  
a magnetoresistance effect device formed on said lower magnetic shield layer through a lower reproduction magnetic gap, said magnetoresistance effect device being as set forth in claim 21 or 23; and  
an upper magnetic shield layer formed on said magnetoresistance effect device through an upper reproduction magnetic gap.
48. A magnetic recording/reproducing head, comprising:  
a reproducing head having a magnetic head as set forth in claim 47;  
a recording head having a lower magnetic pole in common with said lower magnetic shield layer of said magnetic head, a record magnetic gap formed on the lower magnetic pole, an upper magnetic pole formed on the record magnetic gap, and a

record coil for supplying a record magnetic field to the lower magnetic pole and the upper magnetic pole.

49. A magnetic record medium, comprising:

a substrate having a main surface;

a base film having an amorphous layer and a metal crystal layer successively layered above the main surface of said substrate;

a record layer formed on said base film and composed of a hard magnetic film containing Co as a structural element, the hard magnetic film having a bi-crystal structure; and

a protection film formed on said record layer.

50. The magnetic record medium as set forth in claim 49,

wherein said hard magnetic film containing Cc as a structural element has co(110) oriented perpendicular to the surface thereof.

51. A magnetic record medium as set forth in claim 49,

wherein said amorphous layer contains structural elements of said substrate and structural elements of said metal crystal layer.

52. The magnetic record medium as set forth in claim 51,

wherein said amorphous layer is a reactive layer of the substrate and the metal crystal layer.

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53. The magnetic record medium as set forth in claim 49,  
wherein said metal crystal layer has a crystal metal base film, and a reactive  
crystal layer.
54. The magnetic record medium as set forth in claim 49,  
wherein said substrate has a surface layer disposed on the main surface side,  
the surface layer being composed of at least one selected from the group consisting of  
an oxide, a nitride, and a carbide.
55. A magnetic record medium, comprising:  
a substrate having a main surface;  
a base film having a metal crystal layer formed on the main surface of said  
substrate, and a mixing layer between said substrate and said metal crystal layer and  
containing structural elements of the substrate and structural elements of the metal  
crystal layer;  
a record layer formed on said base film and composed of a hard magnetic film  
containing Co as a structural element, the hard magnetic film having a bi-crystal  
structure; and  
a protection film formed on said record layer.
56. The magnetic record medium as set forth in claim 55,  
wherein said hard magnetic film containing Co as a structural element has  
Co(110) oriented perpendicular to the surface thereof.

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57. The magnetic record medium as set forth in claim 55,  
wherein said substrate has a surface layer disposed on the main surface side,  
the surface layer being composed of at least one selected from the group consisting of  
an oxide, a nitride, and a carbide.

58. A magnetic storing apparatus, comprising:  
the magnetoresistance effect device of claim 21, 27, or 38;  
a write electrode for storing information to the magnetoresistance effect film of  
the magnetoresistance effect device; and  
a read electrode, composed of the electrode of the magnetoresistance effect  
device, for reproducing information stored in the magnetoresistance effect film.

59. The magnetoresistance effect device as set forth in claim 21, wherein the bi-crystal  
structure is a crystal structure which is composed of substantially continuously formed  
main grains having an average grain diameter of about 50 to 100nm, each of the main  
grains having a plurality of sub-grains having an average grain diameter of about 10 to  
30nm, each of the sub-grains being oriented in a c-axis direction in its plane, and the  
orientation direction of each sub-grain being substantially perpendicular to an  
orientation direction of an adjacent sub-grain in the main-grain.

60. The magnetoresistance effect device as set forth in claim 21, wherein an under-  
layer having a thickness of 50 nm or less is disposed between the substrate and the

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hard magnetic layer, the under-layer being composed of an amorphous layer formed on the substrate and a crystal layer formed on the amorphous layer.

61. The magnetoresistance effect device as set forth in claim 21, wherein the magnetoresistance effect film is a spin valve film comprising a ferromagnetic film and a non-magnetic film.

62. A magnetoresistance effect device, comprising:

a substrate having a main surface;

a magnetoresistance effect film formed on the main surface of said substrate and having a magnetic field detecting portion;

a pair of bias magnetic field applying films disposed adjacent to both edge portions of the magnetic field detecting portion, the bias magnetic field applying films having hard magnetic films containing Co as a structural element and having a bi-crystal structure, the hard magnetic films having a residual magnetization  $M_r$  of 650 emu/cc or more.

63. The magnetoresistance effect device as set forth in claim 62, wherein said hard magnetic film containing Co as a structural element has Co(110) oriented perpendicular to the surface thereof.

64. The magnetoresistance effect device as set forth in claim 62, wherein said hard magnetic film is composed of CoPt or CoPtCr.

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65. The magnetoresistance effect device as set forth in claim 62, wherein said pair of bias magnetic field applying films are abutted against said magnetoresistance effect film.

66. The magnetoresistance effect device as set forth in claim 62, wherein the bi-crystal structure is a crystal structure which is composed of substantially continuously formed main-grains having an average grain diameter of about 50 to 100 nm, each of the main-grains having a plurality of sub-grains having an average grain diameter of about 10 to 30 nm, each of the sub-grains being oriented in a c-axis direction in it plane, and the orientation direction of each sub-grain being substantially perpendicular to an orientation of an adjacent sub-grain in the main-grain.

67. The magnetoresistance effect device as set forth in claim 62, wherein an under-layer having a thickness of 50 nm or less is disposed between the substrate and the hard magnetic layer, the under-layer being composed of an amorphous layer formed on the substrate and a crystal layer formed on the amorphous layer.

68. The magnetoresistance effect device as set forth in claim 62, wherein the magnetoresistance effect film is a spin valve film comprising a ferromagnetic film and a non-magnetic film.

69. A magnetic head, comprising:  
a lower magnetic shield layer;

a magnetoresistance effect device formed on said lower magnetic shield layer through a lower reproduction magnetic gap, said magnetoresistance effect device being as set forth in claim 62; and

an upper magnetic shield layer formed on said magnetoresistance effect device through an upper reproduction magnetic gap.

70. A magnetoresistance effect device comprising:

a substrate having a main surface;

a magnetoresistance effect film formed on the main surface of the substrate and having a magnetic field detecting portion;

a pair of bias magnetic field applying films, each being disposed adjacent to both edge portions of the magnetoresistance effect film said each of the bias magnetic field applying film comprising an under-layer composed of an amorphous layer and a metal crystal layer formed on the amorphous layer, and a hard magnetic film formed on the metal crystal layer of the under-layer.

71. The magnetoresistance effect device as set forth in claim 70, wherein said hard magnetic film is composed of CoPt alloy.

72. The magnetoresistance effect device as set forth in claim 70, wherein the hard magnetic film has a residual magnetization  $M_r$  of 650 emu/cc or more.

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73. The magnetoresistance effect device as set forth in claim 70, wherein the magnetoresistance effect film is a spin valve film comprising a ferromagnetic film and a non-magnetic film.

74. The magnetoresistance effect device as set forth in claim 70, wherein the hard magnetic film has a bi-crystal structure.

75. The magnetoresistance effect device as set forth in claim 70, wherein the metal crystal layer is formed of a crystal metal material having a bcc structure, the crystal metal material being at least one selected from the group consisting of Cr, V, and an alloy thereof.

76. The magnetoresistance effect device as set forth in claim 74, wherein the bi-crystal structure is a crystal structure which is composed of continuously formed main-grains, each of the main-grains having a plurality of sub-grains, each of the sub-grains being oriented in a c-axis direction in its plane, and the orientation direction of each sub-grain being substantially perpendicular to the orientation direction of an adjacent sub-grain in the main-grain.

77. The magnetoresistance effect device as set forth in claim 70, wherein the under-layer has a thickness of 50 nm or less.

78. A magnetic head, comprising:

a lower magnetic shield layer;

a magnetoresistance effect device formed on said lower magnetic shield layer through a lower reproduction magnetic gap, said magnetoresistance effect device being as set forth in claim 70; and

an upper magnetic shield layer formed on said magnetoresistance effect device through an upper reproduction magnetic gap.

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